

## **SUMMARY OF VITAL SIGNS SCOPING WORKSHOP**

Pinnacles National Monument

September 18-20, 2001

Knowledge about the condition of the natural resources in national parks is fundamental to the National Park Service's ability to protect and manage parks. Park managers are confronted with increasingly complex and challenging issues and are asked to provide scientifically credible information to select and defend management actions. In addition, the National Parks Omnibus Management Act of 1998 includes a Congressional mandate to provide information on the longterm

trends in the condition of the National Park system resources. In response, the Service has identified 270 parks with significant natural resources for which inventories will be completed and long-term ecological or vital signs monitoring will be initiated. A process for these tasks has been developed. The first step is to identify individuals with knowledge about the natural resources and convene a multi-disciplinary workshop to brainstorm ideas. The workshop for Pinnacles National Monument was held from September 18-20, 2001 with 29 participants, see appendix 1 for complete list.

### **WORKSHOP OBJECTIVES:**

1. Write down assumptions and develop a conceptual model.
2. Identify stressors, anything that can affect park resources.
3. Brainstorm potential vital signs monitoring questions, indicators, and sketch out how the monitoring could be accomplished.

Park staff provided current knowledge about the natural resources, the forces of change, and the management issues during a walk through the park and in a meeting room. Discussions were lively punctuated with information from the convened researchers and specialists. The group concurred with the stressor list that park staff provided. Three smaller working groups worked on the vital signs monitoring signs and indicators based on three major resource types: physical, vegetative and wildlife resources. The group reunited to look at common linkages between the potential monitoring needs and the characteristics of a good vital signs monitoring program.

In following the process recommended by the NPS Washington Office, the next steps are as follows:

1. Circulate this workshop summary to a wider group of specialists for additional comments. Included with the workshop summary is a draft of a simplified model of the Pinnacles NM ecosystem and how it functions. This was compiled by park staff, the network I&M Coordinator and selected specialists. The deadline for responses is Dec 8, 2001.

2. Decide on implementation strategies and determine priorities. A small group of specialists will be convened to assist the park with this process, including a statistician
3. Draft the monitoring plan for Pinnacles and have it widely reviewed by scientists and other specialists.
4. Approve and implement the monitoring plan.

The following summarizes the workshop group's discoveries:

#### **POTENTIAL GOALS FOR NATURAL RESOURCE MONITORING:**

This was based on the park enabling legislation, other legal mandates and the workshop discussions. For reference, the park mission statement is included in italics.

The purpose of Pinnacles National Monument is to preserve for their scientific interest the pinnacle rocks and caves, and the surrounding congressional mandated wilderness. The monument contains and protects significant qualities and provides opportunities including: natural dark and quiet; remnant native plant and animal communities; cultural and historical values; class I air quality; outstanding scenery and view sheds; diverse and accessible recreational opportunities; and open space in an increasingly urban setting.

1. Protect pinnacle rocks and caves and associated biota. These are considered primary park resources and a reason the park was created.
2. Preserve wilderness values including natural quiet and dark.
3. Maintain good air quality and visibility.
4. Protect threatened and endangered species and preserve their habitat.
5. Preserve natural processes. Patchiness of habitats in the park creates a high diversity of species.
6. Maintain native plants. Since there has been little unnatural disturbance, there is a high percent of native plant species.
7. Conserve necessary migratory corridors and habitats. Many park animals require a larger space than occurs within the park boundary.

#### **GOALS OF VITAL SIGN MONITORING:**

1. To develop scientifically sound information on the status and trends in the composition, structure and function of park ecosystems, and
2. To determine how well current management practices are sustaining ecosystems.

#### **DEFINITIONS:**

Vital sign = any measurable feature of the environment that provides insight into the state of the ecosystem

Stressor = an effect that creates change

**SUMMARY OF STRESSORS (in decreasing order of social impact):**

- Development/land use (internal and external of the park boundary)  
(air and water pollutants, water quantity, light, ingress of exotic species, decrease in migratory corridors)
- Visitor use  
(noise, wildlife distribution and reproduction, habitat fragmentation, social trails and loss of vegetative cover, soil erosion)
- Exotic species  
(competition with native species, loss of diversity, change in vegetation community structure and wildlife)
- Wildland fire (natural ignition frequency every 40-100 years)  
(vegetative cover, wildlife, erosion)
- Flood  
(catastrophic change and sediment loss)
- Climate  
(global warming)
- Geology  
(uplift and movement northward, earthquakes)

For a complete list of stressors developed at the workshop see appendix 2.

**INFORMATION GAPS AND INVENTORY NEEDS:**

Although this workshop was focused on monitoring needs it became obvious, through the course of discussions, that there were some “data gaps” where baseline inventories were needed prior to development of monitoring strategies. In addition, some of the questions asked by the group were research questions rather than monitoring questions. These two lists have been included to provide a complete picture of the research, monitoring and inventory needs of the Monument, as seen by the interdisciplinary group.

Inventory Needs

- Mass wasting and landslide potential. Management concern: safety. Map historic slides and develop a model of potential hazard zones.
- Soil map. Management concerns: effect of fire lines, location of trails, rehab efforts. Inventory the soils throughout the park, characterize soil geochemistry, water holding capacity and erosion potential.
- Caves. Management concern: visitor use, rare species. Inventory cultural, biological, hydrological and atmospheric resources in significant caves.
- Natural soundscape. Management concern: visitor use, wildlife. Do a baseline measurement.
- Bats. Management concern: rare species, visitor use, distribution.
- Earthworms. Management concern: presence of a non-native earthworm.
- Wildlife disease. Management concern: health and safety. Determine the presence/absence of Hanta virus and Lyme disease.

- Lichens. Management concern: air pollution, visitor use.
  - Rare plants. Management concern: How are sensitive plant species distributed within Pinnacles
  - What was the original vegetation on the Pinnacles Ranch?
  - What is the distribution of mistletoe in the Monument?
- Research Needs
- What is the nutrient flow through the park and how does fire affect it?
  - What are the microclimates in the different ecosystems? Move four portable meteorological stations to different areas of the park once every year.
  - What is the sedimentation rate in the reservoir?
  - What effect do the bolts and chalk have on the rocks?
  - Do social trails have an effect on geophysical resources? (compaction, increased erosion)
  - What effect is noise having on natural quiet and biological resources?
  - What effect is human sanitation off trails having on water quality and other resources?
  - What is the water quality entering the park?
  - What effect do land use changes (maintenance activities, restoration activities) within the park have on geophysical processes
  - What are the biological and geochemical effects of air pollutants (ozone)?
  - What is the flushing distance for selected species of birds?
  - What are the impacts of the non-native turkey, what do they eat, reproductive rates?
  - What are the impacts of starlings to cavity nesters?
  - Would the distribution of gray pines be an appropriate vital signs indicator that is sensitive to fire, flood or air pollution?
  - What are key pollinators for important native plant communities?
  - What is the carrying capacity for visitors by trail, climbing route, etc.?
  - Do existing or impending exotic species have geophysical effects, including flora and fauna?
  - How do feral pigs modify nutrient cycling, soil development and erosion?
  - What effects to the pig fence have on channels that it crosses.
  - What impacts to pigs have on biological systems – specifically salamanders, earthworms, vegetation – looking inside and outside fence?
  - What affect does the fence have on limiting the distribution of species, both plant and animal?
  - What species are truly affected by pigs?
  - How are pollutants affecting biological and physical systems in the rock/scree community?

See appendix 3 for additional research questions developed by Pinnacles's staff.

#### **POTENTIAL VITAL SIGN MONITORING QUESTIONS RATED HIGH:**

This process was thought to be helpful in developing specific monitoring goals and objectives. The objectives will be based on the park's enabling legislation,

legal mandates (wetlands, threatened/endangered species, wilderness), planning documents such as the General Management Plan, stressors affecting park resources, and other management needs.

#### Vegetation and Fire resources

1. What is mortality, recruitment and general demography of gray pine in and outside the Monument?
2. Is oak recruitment and Mortality within the natural range of variation within the coastal range?
3. How is the gross vegetation community within and adjacent to the park changing? (aerial photos every 5-10 years)
4. Is the distribution and abundance (both actual and relative) of non-native species changing within the Monumet? Are there areas where change is happening more quickly? (fence, roads, trails, burned areas, grazed lands, flooded areas, specific habitats)
5. What are the frequency, spatial distribution, intensity and source of fires that occur in the Monument?
6. Are there changes in the native bulb species distribution and abundance as a result of pigs, both inside and outside fence?
7. Is the distribution and abundance of riparian species changing as a result of changes in watertable, flooding etc.?
8. Are there changes in distribution and abundance of native bunchgrasses, and can areas at Pinnacles be used as reference areas for more disturbed sites?
9. Is the distribution and abundance of plant species from southern California and northern California at the edge of their range changing?
10. Is the distribution and abundance of plant species becoming rare outside of the park changing within the park?

#### Wildlife resources

1. How does wildlife respond to habitat structure and change in structure through time?
2. Is species "X" increasing or decreasing parkwide and within specific habitats including exotic species?
3. To what extent is Pinnacles National Monument connected to surround open space and how is this changing over time?
4. What kind of habitat does the pinnacles formations provide and for which species over time?
5. How is the aquatic community changing from year to year?
6. Can we use an index of mortality to determine effects of development and use both outside and inside Monumnet?
7. What is the health of California Thrasher, Sage Sparrow, Wrentit, Blue-grey gnatcatcher, Spotted Towhee related to successful reproduction?
8. What is the health of raptors and ravens related to successful reproduction?

### Physical resources

1. How are park roads, trails and parking lots and restoration activities, modifying sediment load, nutrient flow, hydrology, groundwater recharge?
2. What are the changes of land use zoning, and development within 250km of park which effect viewsheds, air, water and light pollution in the park?
3. Are park and surrounding community activities mining groundwater?
4. How are activities altering quality and quantity of water entering the park?
5. What impact is climbing having on the park's number one resource The Rock? How does chalk and bolting effect rock erosion?
6. Do we know where all of the social trails and other areas of soil compaction/erosion activities? Are they getting better or worse?
7. What levels, timing and numbers, spatial distribution, of visitor activities are occurring in park?
8. How can internal park air pollution sources be reduced to improve the park's impact on regional air quality?
9. How are human sanitation issues, both above and below ground, affecting park resources?
10. What are the fire frequency, intensity, size and seasonality of fires and floods in the park? Where are the hydrophobic soils?
11. What is the hydrologic pattern of the park including drying patterns?
12. What is the natural variability range of sediment flow related to fire and flood?

### **POTENTIAL IMPORTANT LINKAGES**

In order to attempt to correlate the information into a vital signs monitoring scheme, the discussion was expanded to examine linkages between the specific components of the ecosystem that each of the three groups had identified. Sampling design similarities became the primary means of linking different project types. Other linkages were based on the need and method for sharing data to expand the area of focus and the need to document events and visitor use for effects to the resources.

1. The **matrix grid system** of establishing sampling locations could be used for various monitoring schemes for terrestrial resources. It was agreed that this system was better than a stratified survey design, since the monitoring goal is to measure change over time. Multiple disciplinary teams could look at a variety of resources under this sampling design. Even though timing of monitoring for each resource type may not be the same, compiling more than one type of information at each sample point would result in data layering and a very robust data set.

Resources that could be monitored include:

- a) animal occurrence using an array for different taxa (small mammals,

- herps, invertebrates (bees and other pollinators), birds)
- b) vegetation (bare ground, herbs, shrubs, trees for cover, species richness...)
- c) geology (soil type, slope, ground moisture content...)
- d) climate (temperature, relative humidity, rainfall)

Issues that could access this information to improve understanding and assist management decision-making include:

- a) fire effects mapping
- b) flood effects mapping
- c) spread of exotic plants and change in population size
- d) plant species occurrence at the edge of their range
- e) plant species occurrence becoming rare
- f) oak mortality
- g) triggers for landslide and erosional areas
- h) sediment budget in watersheds
- i) compliance document preparation and comments for projects

2. **Riparian area monitoring** would need a different monitoring scheme but may be able to incorporate points from the matrix grid system.

Multidisciplinary groups could also be used.

Areas of study could include:

- a) surface water quality and quantity
- b) vertebrate animal demography, especially amphibians (frogs)
- c) invertebrate indicator species (indicators of presence of pollutants)
- d) sediment budget

Issues that could use this information include:

- a) sanitation and effects of campgrounds, septic systems...
- b) developmental changes to the watershed shape and sediment budget
- c) presence and effects of exotics
- d) presence of pollutants
- e) change in water use patterns
- f) potential for flooding and landslides

3. The **aerial photograph/GIS system** captures more regional scale information that could be used to monitor the following:

- a) gross vegetation community change
- b) landuse of external neighbors and gross landscape change
- c) exotic plant communities that have a specific signature detectable with aerial mapping
- d) wildlife corridor connectivity

- e) habitat fragmentation
- f) recovery and habitat change after catastrophic events such as fire, flood, landslide

Uses of this type of information could be helpful in resolving these issues:

- a) impacts from external land use
- b) source locations for exotic species ingress
- c) changes to stream flow upstream of the park

The issue of scale and size of the core area were not determined.

4. **Air quality** is already being monitored at three locations within the park. In order to understand regional level issues, stations outside the park could be identified and included. Air quality effects to include monitoring of sensitive species such as lichens. On a more local scale, internal sources of air pollutants could be documented. Monitoring of lichens could also provide information about recreational rock climbing effects.
5. Documentation of **catastrophic events** that have the capability of ecosystem-level change was thought to be an important aspect of the monitoring across all resources. Seasonality, intensity, duration and area of each event was thought to be important for:
  - a) fire
  - b) flood
  - c) landslide
  - d) ground disturbance in/around a riparian area
6. Documentation of **visitor use** was also thought to be important. Both number of visitors and type of use could be documented for various selected areas of the park. Some of the matrix locations may be included as locations. Visitor uses included:
  - a) hiking
  - b) climbing
  - c) drivingResource affects from visitor use could include:
  - a) soil compaction and erosion related to trails
  - b) vegetation trampling adjacent to trails
  - c) number of social trails
  - d) climbing impacts to the Pinnacle rocks from pitons...
7. A few specific **issue-driven topics** did not fit neatly into one of the above but were thought to be important:
  - a) spread of disease and oak mortality
  - b) rate of groundwater mining within and around the park
  - c) nest parasitism (nest searches for 5 bird species)

d) raptor species demography could expand to include more than just the falcons using the Pinnacle rocks

8. Linkages included communication and sharing of information with **park neighbors** and other agencies to improve stewardship and protection of resources.

These groups included:

- a) agricultural neighbors
- b) California Fish and Game
- c) Fish and Wildlife Service
- d) the many University researchers
- e) the San Francisco Bay network of park specialists other monitoring sources along migratory corridors

### **CHARACTERISTICS OF SUCCESSFUL LONG-TERM MONITORING PROGRAMS (over 10 years):**

1. Simple. There is an understandable indicator, simple training, cheap and easy to use protocols for monitoring.
2. Scientific. Monitoring protocols and vital signs indicators are peer-reviewed initially and periodically thereafter (every five years for Pinnacles). Inferences can be made to a larger population or region. Precision will increase as the number of years of sampling increases.
3. Standard. Protocols are standard with good quality assurance and control. Sampling protocols are not changed unless there is an overlap between methods for several years.
4. Statistical. Indicators are measurable, the hypothesis and statistical measurements are determined in advance, bias is minimized, data show a trend or change (at least 10-12 years of data are often required).
5. Sustainable. Cost and manpower are minimized, logistical support is easy.
6. Systematic. Measurements are repeatable over regular intervals to tease out trends. Permanent plots revisited over time and regular sampling intervals are recommended since the objective is to detect change over time.

Development of sound data management practices and required annual reports is the key to making this program work. The experience of successful monitoring programs is that at least 30% of total funding should be used for data management and reporting. Also integral to success is for one park staff

Pinnacles National Monument Vital Signs Scoping Workshop Summary 10 member be responsible for both the I&M program and for the research permits so that they can be linked.

A major emphasis of this program is to make information more readily available. It is anticipated that vital signs information will be used in various ways:

- Management of the park. Information needs to be available to and interpreted for the planning and decision-making process and the compliance process.
- Education. Photos of how the monitoring is done and how the monitoring is used are important. Information may also be made available through NPS web sites as well as normal avenues such as ranger talks, pamphlets, and waysides.
- Expand boundary through partnerships. Since park staff will not be able to do the entire program themselves, partners will be needed for technical knowledge, funding, manpower, and specialized equipment. Evaluations become based on a larger landscape. Park neighbors become involved and interested in protecting their resources also.
- Multi-disciplinary approaches are encouraged. Costs are reduced for all participants. Synergistic opportunities abound. Shared data and methods make data sets more robust.

#### **VITAL SIGN INDICATORS SELECTION CRITERIA:**

In order to prioritize indicators to monitor park resources, the following selection criteria will be used (taken from the Lake Mead NRA 1998 workshop). The monitoring indicator:

1. has low impact to all resources
2. has measurable results that are repeatable with different personnel
3. has results that can be interpreted and explained
4. has costs that are not prohibitive
5. can be accurately and precisely estimated
6. is distributed over a wide geographical area and/or is very numerous
7. has dynamics attributed to either natural cycles or anthropogenic stressors
8. has low natural variability
9. is sensitive enough to provide an early warning of change
10. has dynamics that parallel those of the ecosystem or component of interest

## Appendix 1 – List of Vital Signs Workshop Participants

| <u>Invitee</u> | <u>Expertise</u>   | <u>Position</u>                      |
|----------------|--------------------|--------------------------------------|
| Ray Sauvaget   | ecology            | NPS science advisor/SAMO Chief of RM |
| Bruce Rogers   | geology/caves      | USGS geologist                       |
| Reg Barrett    | wildlife           | UC Berkeley professor                |
| Minda Troost   | geology            | NPS-PINN physical scientist          |
| Clay Fletcher  | wildlife           | NPS-PINN temporary biologist         |
| Jon Keeley     | fire ecology       | UGSG-BRD                             |
| Judy Rocchio   | air quality        | NPS natural resources                |
| Tom Parker     | fire ecology       | San Francisco State professor        |
| Steve Alsup    | wildlife           | NPS-PINN temporary biologist         |
| Sam Webber     | biologist          | NPS-CABR chief of resource           |
| Peggy Herzog   | fire ecology       | NPS fire ecologist                   |
| Steve Acker    | natural resources  | NPS regional I and M                 |
| Grant Ballard  | ornithologist      | PRBO                                 |
| Leslie Chow    | wildlife ecologist | USGS-WERC                            |
| Tom Leatherman | botany             | NPS-PINN botanist                    |
| Keith Barker   | fire               | NPS-PINN fire                        |
| Chad Moore     | earth science      | NPS-PINN physical scientist          |
| Amy Fesnock    | biology            | NPS-PINN wildlife biology            |
| Terry Griswald | entomologist       | Utah Bee Lab Researcher              |
| Jenny Bjork    | ecologist          | I and M network coordinator          |
| Paul Johnson   | zoology            | NPS-PINN temporary biologist         |
| Jay Goldsmith  | natural resources  | NPS natural resources                |
| Sarah Allen    | wildlife           | NPS science advisor                  |
| Paul Reeberg   | fire, vegetation   | NPS ecologist, monitoring            |
| Howard Sakai   | wildlife ecologist | REDW                                 |
| Julie Hammon   | veg                | BLM                                  |
| Ben Becker     | aquatic ecologist  | PORE Learning Center Director        |
| Dawn Adams     | wildlife           | PORE I&M Coordinator                 |

## Appendix 2 – Complete list of stressors from workshop

### **Development**

- Loss of open space
- Habitat fragmentation – landscape patterns
- Air pollution – toxins and fertilizers
- Park – roads, trails, bridges, footprint
- Water use, septic
- Poachers
- Light pollution
- Visibility
- Viewsheds

### External Development

- Habitat loss - conversion from low intensity to high intensity
- Habitat fragmentation and loss of connectivity -spatial distribution of remaining open space
- Changing agricultural practices
- Nutrient loss in developed lands further isolates our systems
- Pesticide drift
- Air quality/Pollution
- Noise - soundscapes
- changes in the zoning within the area

### Internal Development

- Restoration - activities
- loss of large contiguous patches

### **Visitor Use**

- Climbing – direct rock impacts
- Climber access areas
- Shortcutting
- Wildlife disturbance – sight and sound
- Climbing - bats, raptors
- importing exotics (seeds, animals)
- Hiker disturbance of wildlife (timing, numbers, spatial distr.)
- Impacts to caves
- Feeding wildlife
- Playback of animal sounds disrupting activities
- Trash
- Vehicle impacts (cars and bikes) - runoff, road kills, sound,
- Trail maintenance - erosion and compaction
- Sanitation
- Personnel (park and researchers)
- Noise
- Use of the landscape in terms of products (edibles)

**Exotics species**

- Pigs Fence impacts
- Non-native plants
- Sunfish
- Effects on soil biota (exotic worms)
- Exotic ants
- Starlings (other birds)
- Exotic bees
- Earwigs
- time and spatial distribution of exotics
- routes of introductions
- Wildlife diseases
- Plant diseases
- Factors contributing to expansion of exotics
- Degree of threat
- Competition with natives

**Fire**

- Vegetation composition and diversity
- Vegetation reproduction
- Wildlife population changes
- Soil modification (hydrophobic)
- Air quality
- changes in ignition sources
- Fire frequencies
- Fire size
- Fire intensity
- Vegetation distribution
- Seasonality/Timing
- Duration
- Control effects (+&-)
- Slope stability (erosion)
- Increased susceptibility to exotic invasions
- Management and human development policies
- Soil chemistry changes
- changes in landscape outside and inside that lead to modification of these events

**Floods**

- Bed and Bank Erosion
- Habitat loss and creation
- Flow
- Inundation
- Introduction of exotics

- changes in landscape outside and inside that lead to modification of these events
- Transportation of resources into or out of Monument
- Money - cleaning up after the mess
- Changes in water yield and watershed
- Structures in stream to mitigate effects
- response of our actions on downstream users
- introduction of pollutants

### **Climate Change**

- Drought / Quantity
- Timing
- Temperature
- Changes (Trends)
- climate cycle
- effects on fires and floods
- species distribution
- atmospheric chemistry changes
- variability

### **Geology**

- Mass wasting
- Weathering / soil development
- Tectonics
- Earthquakes – talus caves
- general erosion
- acid deposition
- earth surface activities(Fluvial)

### **Other ideas**

- Look at migratory species at other locations in there life cycle
- tie into monitoring programs at other sites on migratory paths

### Appendix 3 – Research Needs Identified by PINN Staff

1. Impact of climbing chalk on the physical structure of the Pinnacle rocks.
2. Impact of climbing bolting to the structural integrity of the Pinnacle rocks.
3. The causes of "pygmy" chamise. (Chamise chaparral that is >40 years old, but only 2-3 feet tall)
4. Distribution of Coast Horned Lizards and the associated ant fauna
5. Impacts of high ozone on indicator plant species as well as general plant flora.
6. Cave temperature/humidity modeling
7. Landuse history of the Chalone Creek Watershed
8. Long-term monitoring of geomorphic change of Chalone Creek
9. Response of creeks to fire frequency and climate change
10. Analysis of central California Climate based upon floodplain sediments, tree rings, and woodrat middens at Pinnacles NM
11. Reconstruct past climates, esp El Nino Phenomenon
12. Assess the Chalone Creek Fault as the Ancestor of the San Andreas Fault
13. Bee faunal associations with fire following plant flora
14. Distribution of Soil Types and Surficial Geology (entire park, not just new lands)
15. Document the recovery of the landscape after the removal of feral pigs both vegetation and soil stability
16. Reintroduction of Foothill Yellow Legged Frogs
17. Reintroduction of Western Spade-foot Toad
18. Assess spatial/temporal distribution of sycamores and willows and the impacts to Western Red Bats
19. Assess the viability of Valley Oaks, are they a remnant Pleistocene species?
20. Distribution and impact of mistletoe
21. Understand the impacts of Feral pig fence on movements of Black-tailed deer fawns
22. Impacts of grazing and fire on bee faunal distributions
23. Impact of fire on bats
24. Distribution of crack/crevice roosting bats and potential impacts of rock climbing.
25. Determine the human carrying capacity of PINN
26. Evaluate visitor use of trail system and impacts to wildlife use of these habitats
27. Determine the source of pollution causing PINN to exceed National standards of ozone (air distribution/movement map)
28. Regeneration of Blue Oaks related to fire and grazing
29. Inventory of Moth species and determination of good indicator species for long-term monitoring efforts.

Also, anything related to climbing and impacts on the natural system would be encouraged, anything on fire effects on wildlife, anything related to bats --

foraging ecology, roosting, etc., anything associating visitor use and changes in wildlife habitat use.